Deposits in the Soil

The activity currently in the soil at the separations areas consists of the inventory in the soil under seepage basins, several leaks into the ground from waste transfer operations, fallout from stacks, general burial waste, and possible (but unconfirmed) leaks to the soil under the canyon buildings from spills inside the building. Decay of short-lived activities reduces the inventories of activities in these places to less than the sum of all input activity. An estimated 10 to 500 Ci of ^{137}Cs remains in the ground from an H-Area waste tank leak (Tank 16), and an estimated 75 to 100 Ci of ^{137}Cs remains from an overflow when a waste tank inlet riser plugged during a transfer (Tank 9). In this last case, most of the contaminated ground was excavated and transferred to the burial ground. Waste containing an estimated 3000 to 5000 Ci of ^{137}Cs escaped into the soil below grade adjacent to Tank 8 in 1961 when the tank was temporarily overfilled. However, the radioactivity has been tightly held by about 1000 ft^3 of soil 14 to 26 ft below grade (18 ft above the main water table) and has not migrated (see p III-86 for additional information).

Minor amounts of activity have also been deposited in the soil infrequently from other abnormal operations. It has been standard practice to note the location and date of the occurrence with a marker and, where possible, to remove the contaminated soil to the burial ground and cover the residue in the soil with asphalt or clean soil. Most of these locations were contaminated years ago with mixed fission products, and most have decayed to low radioactivity levels. These locations are described in Appendix A.

FUEL AND TARGET FABRICATION (300 AREA)

The facilities for fabricating fuel and target elements to be irradiated in SRP reactors are located in the 300-M Area. Major products are extruded enriched uranium-aluminum alloy fuel and canned depleted uranium metal targets. The only significant radioactive release from these facilities is uranium in aqueous effluents from the canning process. The total amount released since 1955 is about 85,000 lb or 24 Ci of uranium. About 50% has settled in plant stream and pond beds adjacent to the area and has not reached the main stream leading to the river.

The 300-Area processes currently result in annual releases of about 34,000 lb of nitric acid and oxides of nitrogen to the atmosphere; about 500,000 lb of acids, bases, and salts in solution to a settling basin; and about 2,000 lb of uranium to a plant stream. The uranium will be discharged to the settling basin when the plating line rinse water is diverted in late 1976.

Alloy Extrusion (321-M)

Process Description and Operation

Tubular fuel and target elements to be irradiated in SRP reactors are manufactured by coextrusion of a composite billet, a process in which the tube is formed and the core is simultaneously clad with aluminum. Cores consist of fuel or target material dispersed in an aluminum matrix. Most elements manufactured in the 321-M building contain enriched uranium cores, but some contain plutonium and neptunium cores that are fabricated in the separations areas. After extrusion, tubes are chemically cleaned to remove graphite and lead-oil lubricant. They are successively treated with hot perchloroethylene, caustic solution (sodium hydroxide), and nitric acid, with intermediate and final water rinses.

Liquid Releases

Radioactive aqueous wastes result from various cleaning solutions if a cladding break exists (uranium, plutonium, or neptunium) and from chemical milling solutions (uranium). Tubes and cleaning solutions are monitored for evidence of cladding breaks with resultant core dissolution and solution contamination. Contaminated solutions are analyzed and then either released to the 300-Area settling basin or retained for possible treatment in the separations areas waste management facilities. About 500,000 gal of water is discharged to the settling basin each week. A total of 0.019 Ci of $^{235,238}U$ was sent to the 300-Area settling basin in 1975.

Atmospheric Releases

Off-gas exhausts from various 321-M operations that are potential sources of radioactive release are vented through High-Efficiency Particulate Air (HEPA) filters to the atmosphere outside the building. HEPA filters are required to retain 99.97% of particles 0.3 μm or greater in diameter. The exhaust downstream of the filters for the casting furnaces used to prepare U-Al billets is monitored by daily filter-paper samples, and process conditions are adjusted if releases increase.

Off-gases from the perchloroethylene-caustic-nitric acid cleaning process are released from a 100-ft stack (total stack discharge flow is about 32,000 ft^3/min). Air sampling equipment is periodically used to monitor activity concentrations in the stack and at other locations in the building to provide data toward minimizing releases.

HEPA filters from off-gas exhausts are analyzed and buried in the burial ground if they contain less than 20 g ^{235}U. Filters with more than 20 g are sent offsite for recovery of ^{235}U. Scrap graphite from the casting process is buried in the burial ground (<0.3% ^{235}U), or processed for ^{235}U recovery if warranted (>0.3% ^{235}U).

Uranium Metal Element Fabrication (313-M)

Process Description and Operation

Fuel and target elements for SRP reactors with natural (0.7% ^{235}U), depleted (about 0.20% ^{235}U), or slightly enriched (up to 1.1% ^{235}U) uranium have been bonded in aluminum cans by several techniques in the 313-M facility. Since 1968, only depleted uranium cores have been used, with the exception of some experimental cores containing 1.1% ^{235}U processed in 1972. Fabrication steps are outlined below.

The depleted uranium cores (which are manufactured offsite) are cleaned at SRP with boiling perchloroethylene and hot nitric acid, anodically etched, and then electroplated to form a 0.3-mil-thick nickel layer. The nickel assures a good bond with the aluminum can and protects the uranium from oxidation during heating. The nickel-plated core is loaded into an aluminum can, capped, preheated to 540°C, and pressed through a die to size the can onto the core. This sizing operation forms a diffusion bond between the nickel and aluminum. The canned elements are cleaned by walnut shell blasting, trimmed, welded, and inspected. They are then cleaned with hot caustic followed by dilute nitric acid at room temperature. They then receive a final test in a steam autoclave to detect cladding defects.

Liquid Releases

Elements failing quality control requirements are reprocessed after the aluminum cladding is dissolved in caustic and the nickel plate is dissolved in nitric acid. Caustic solutions are released to a settling basin; nitric acid is sent to the 313-M uranium recovery facility.

When the acid solutions used in the various processes reach a uranium concentration of 100 g/l and the anodic etch solution reaches 16 g/l, they are treated with caustic to precipitate uranyl hydroxide, and the slurry is processed through a rotary filter. The filter cake is removed continuously during filtration, and the depleted uranium precipitate is sent to the burial ground. A filter press is used to recover aqueous suspensions of

UO_2 resulting from autoclave failures. This material is also sent to the burial ground. These filter operations recover about 99% of the uranium from solution; the remainder is released to the settling basin.

Rinse water is currently discharged, via the 300-Area waste water system, into Tims Branch, which empties into Steeds Pond, about 1-1/2 miles from the 300 Area; overflow from the pond runs into Upper Three Runs after another 2 miles, and then to the Savannah River. Every 15 minutes, the effluent is sampled in amounts proportional to the flow (about 5 million gallons per week for the total system); samples are combined and analyzed every week to determine the weekly release of uranium. In 1975, 0.44 Ci of depleted uranium were released to Tims Branch. A process sewer to convey 313-M waste solutions to the 300 Area settling basin was completed in 1973. Acid, caustic, and salt solution wastes are diverted through the sewer to this basin. The rinse waters containing uranium and nickel from the electroplating process will be diverted to the basin in late 1976.

Atmospheric Releases

Off-gases from nitric acid processes are exhausted through three 100-ft stacks at 8,000 to 14,000 ft^3/min. Most other exhaust air streams are vented directly to the atmosphere outside the building. No particulate filters are used in the atmospheric exhausts from 313-M because of low potential for radioactive release. Ventilation air to the stacks and in other building locations is sampled for particulate activity continuously, and the filter paper samplers are monitored daily.

Target Extrusion (320-M)

The 320-M building contains facilities for extruding lithium-aluminum tubes for tritium production. An analytical laboratory is also located in the building. Aqueous releases mix with the 313-M effluent to Tims Branch and are included in the weekly analysis. Various off-gas exhausts in the extrusion process contain HEPA filters for particulate removal. Because the amounts of radioactive material handled in this facility are low, potential for radioactive release is minimal.

Test Reactors (305-M)

A low-power test reactor and a subcritical test reactor in the 305-M building are used to test the fabricated reactor elements. No waste effluents are generated in normal operation.

Metallurgical Laboratory (322-M)

This facility handles various materials, including test specimens of all materials fabricated in the 300 Area. Some irradiated materials are also examined here. Ventilation air from various operations exhausts through HEPA filters and is vented from 25 and 50 ft stacks. Aqueous releases are sent to the settling basin together with those from 321-M.

Nonradioactive Releases from 300-Area Facilities

The major nonradioactive releases to the atmosphere from the 300-Area processes are nitric acid and oxides of nitrogen resulting from various acid etching, cleaning, and plating operations. The airborne chemicals are released through the 100-ft stacks previously described. The walnut shell blast cleaning process used in 313-M since 1970 eliminated a source of about 35,000 lb/yr (as NO_2). In 1973, NO_x emissions from 321-M (primarily HNO_3 mist) were reduced from about 180,000 lb/yr to about 18,000 lb/yr by reducing the concentration and temperature of the HNO_3 cleaning solution.

Aqueous releases (mainly rinse water) to Tims Branch contain nickel and uranium compounds from plating line rinse water, and methanol from drying operations. The acid, caustic and salt solution wastes from 321-M and 313-M are sent to the settling basin.

HEAVY WATER PRODUCTION AND RECOVERY (400 AREA)

In the 400-D Area, heavy water (D_2O) is separated from Savannah River water by a hydrogen sulfide extraction process, with final purification by distillation. The most significant release of radioactivity from the 400 Area is tritium from the reprocessing of degraded reactor D_2O coolant that is reprocessed in a separate distillation facility. In 1975, 3,000 Ci of tritium were released to the atmosphere and 1,600 Ci to Beaver Dam Creek. The major nonradioactive releases from the area in 1975 are about 180,000 lb/yr of SO_2 and about 180,000 lb/yr of H_2S to the atmosphere from the heavy water extraction plant.

The largest steam power plant (484-D) on the plantsite is located in the 400 Area. Its operation and effluents are discussed under "Support Functions."

Rework Unit (420-D)

Process Description

The Rework Unit consists of four distillation towers and associated equipment for removing H_2O that has accumulated in the D_2O coolant used in the reactors. This degraded coolant contains some tritium.

The Rework Unit operates in two stages: a waste campaign and a product campaign. During the waste campaign, the H_2O distillate is not allowed to contain more than 0.45 mol % D_2O and normally averages 0.4 mol % D_2O. All distillate collected at these low concentrations is discarded to the sewer and subsequently reaches Beaver Dam Creek and the river. The waste campaign feed stock is tritiated, degraded coolant containing 1.25 to 40 mol % D_2O. Product from this campaign contains about 50 mol % D_2O and is stored as feed for the product campaign.

During the product campaign, the base concentration in the Rework Unit is maintained above 99.00 mol % D_2O, and product is withdrawn at this concentration for shipment to the 100-Area reactor systems. Feed stock is the tritiated, degraded coolant already concentrated to 40 to 99.0 mol % D_2O. Distillate collected during the product campaign, at a concentration of about 30 mol % D_2O and 70 mol % H_2O, is stored as feed for the next waste campaign.

Tritium in the distillate collected during the waste campaign is the major source of radioactive releases to plant streams from the Rework Unit. Because tritium concentrates in the product stream in preference to the waste stream, the average concentration of tritium in the discards is lower than in the feed material and is not recoverable on a practical basis.

Aqueous Releases

Waste campaign distillate is collected in tanks and analyzed before being discharged (at 1 gpm) to the cooling water effluent (1300 gpm), which goes to Beaver Dam Creek as a part of the total area discharge of about 40,000 gpm. The discharge rate is adjusted to meet procedural controls on tritium concentrations in the effluent sewer (currently <0.1 μCi/ml) and on total quantities released. 1975 tritium releases were 520 Ci.

Atmospheric Releases

Tritiated heavy water evaporated from leaks in the Rework Unit pump room and in the drum handling building is released to the atmosphere through a 70-ft stack with 13,000 ft^3/min air flow. Exhaust vapors from tanks and drums pass through an ammonia-cooled condenser and then are vented into the exhaust stack. A Kanne chamber monitors this air for tritium, to detect leaks and estimate releases. 1975 tritium releases were 1,150 Ci.

Drum Cleaning Facility (421-2D)

Fifty gallon drums used for heavy water storage and transport are cleaned with either acid or alkaline phosphate solutions before reuse. Drums used for degraded D_2O coolant retain some tritiated water, and this is the major source of activity release from this facility. Spent cleaning solutions are stored in two tanks and pumped to Beaver Dam Creek in about 16,600-gal batches after analyses to confirm the acceptability of release. The solution may be transported by tank truck to the 200-F Area waste treatment system if sufficient radioactivity is present, as compared to prorated fractions of operating guides. 1975 tritium releases were 550 Ci. The primary aqueous chemical waste from the 400-D Area is 10,000 lb/yr of trisodium phosphate and 9,000 lb/yr phosphoric acid from the drum cleaning facility. The average concentration is $\sim$0.1 ppm PO_4^{3-} in the total area effluent flow of 40,000 gpm.

Atmospheric releases are estimated from 15-minute samples taken four times each month from the hood exhaust. 1975 tritium releases were 400 Ci. Instrumentation is presently being installed to continuously monitor for tritium.

Analytical Laboratory (772-D)

The quality control laboratory in the 400 Area serves both the heavy water area and the reactor areas. Aqueous releases to a plant stream are sampled continuously and analyzed monthly. 1975 tritium releases were 550 Ci.

Atmospheric releases occur from laboratory hood exhausts and exhausts from drum storage for recovered heavy water. The main laboratory stack is sampled continuously to estimate releases. 1975 tritium releases were about 1,300 Ci.

Extraction Plant (GS Process, 412-D)

An eight-unit extraction building provides the first stage concentration in the separation of D_2O from river water. Two similar buildings were dismantled. The single plant processes 2700 gal/min of river water with an inlet natural D_2O concentration of 0.015 mol %. A dual-temperature process utilizes countercurrent extraction with H_2S gas. This process yields about 2.5 gal/min of 8 mol % D_2O, which is transferred to the distillation plant for further enriching.

The GS extraction plant releases SO_2 to the atmosphere from the burning of H_2S gas in a 400-ft flare tower. About 30% of the H_2S gas lost from the process is via this route; 30% is released in a purge gas stream as H_2S from the 400-ft tower (but not burned), and 30% leaks from the system as H_2S. The remaining 10% is distributed between aqueous H_2S releases and solid sulfur recovered and burned to SO_2. The solid sulfur is formed by oxidation of H_2S gas, is deposited in various places in the system, and is removed during overhaul. The estimated annual loss is equivalent to about 150 tons of H_2S. About 13,000 gal per year of waste seal oil, contaminated with H_2S from the GS process, is burned in the 484-D powerhouse.

Distillation Plant (DW Process, 420-D)

This unit contains towers similar to those in the Rework Unit, and the principles of operation are similar. Product from the GS plant is upgraded to 99.75 mol % D_2O at a rate of 0.08 gal/min. Distillate is returned at a concentration of 6 mol % D_2O to the appropriate feed point in the GS process. About 3000 lb of ammonia is released to the atmosphere annually from the distillation plant refrigeration system.

SAVANNAH RIVER LABORATORY (700 Area)

The Savannah River Laboratory (SRL) has primary responsibility for research and development activities at the Savannah River Plant and also has been responsible for small-scale manufacturing activities. Laboratory operations are conducted in the Technical Area, TNX-CMX semiworks near the river, Thermal Effects Laboratory on Upper Three Runs, Par Pond Area, and U Area.

Releases of radioactivity from SRL facilities are low; 1975 emissions from all sources included 600 Ci of tritium and 30 μCi of beta-gamma activity to the atmosphere, 0.002 Ci of alpha activity to plant streams, and 4 Ci of tritium, 0.005 Ci of alpha activity, and 0.008 Ci of beta-gamma activity to seepage basins.

Description of Facilities

Locations of various research and development facilities of the laboratory in the 700-A Area are shown in Figure II-10. The main laboratory building (773-A, divided into Sections A through F) houses most of the research and development activities. The activities with the highest potential for release of radioactivity are described in the following paragraphs.

Fabrication

Fuel Element Prototypes. Fuel element prototypes of both natural and enriched uranium are fabricated in D Section of 773-A from metal, alloy, and oxide feeds by casting, machining, cladding, extrusion, and other operations. Economically recoverable scrap from these operations is usually returned to 300-M Area for recovery or is remelted as part of an alloy charge. Solid wastes are sent to the burial ground. Spent acidic and caustic degreasing and pickling solutions used in fabrication operations are discharged to the trade waste system unless they contain uranium or thorium >3 g/l, in which case they are transferred to 300-M Area for recovery. Trichloroethylene degreasing solutions are purified for further use.

Targets. Oxides of americium and curium separated from previous reactor campaigns are refabricated into targets for further irradiation to produce ^{252}Cf and other higher isotopes. The targets are produced in infrequent campaigns in a target fabrication facility in the F Section. This facility has three containment boxes within a separately ventilated enclosure shielded by water tanks and concrete. Operations are by master-slave manipulators, and an inert atmosphere (argon or dry nitrogen) is maintained in the containment boxes. Gases exhausted from the boxes pass through three stages of high-efficiency particulate air (HEPA) filters before discharging to a stack. Liquid wastes are disposed of to the high-level drain system, and solid wastes are bagged before shipment to the burial ground for burial in concrete.

Sources. Fabrication and testing of various types of radioisotope sources are developed in contained and/or shielded facilities tailored to the particular radiation characteristics of the sources involved. These sources include:

- *^{252}Cf neutron sources for industrial and medical applications*. The industrial sources, containing up to 30 mg of ^{252}Cf as oxide, are doubly encapsulated in platinum, palladium, Zircaloy, or stainless steel in the target fabrication facility or the californium packaging facility in F Section. The californium packaging facility has three containment boxes ventilated by a once-through flow of air exhausting through three stages of HEPA filters and one charcoal filter.

  The ^{252}Cf medical sources, up to 30 μg, are fabricated in a series of five smaller containment boxes in F Section; the boxes are shielded by concrete blocks and ventilated by once-through air with three stages of filtration.

- *^{238}Pu sources for space power systems*. Development of fabrication techniques and performance tests of suitable fuel forms are performed in the alpha materials facility located in C Section of 773-A. This facility contains a series of glove boxes with once-through flow of air receiving three stages of filtration before discharge to a sand filter.

Separations

Research and development on separations processes involves both laboratory and pilot-scale work, primarily in B and C Sections and, to a lesser extent, in E Section; process operations include the handling of irradiated fuel and targets to the packaging of final product. Process study areas with the highest potential for releases to the environment are described below:

- Venting of containment systems, regeneration of cold traps in inert atmosphere purification systems, and replacement of pump oil in vacuum systems are potential avenues for release of tritium as the elemental gas, water vapor, or part of a solvent molecule. Releases may be controlled administratively at low concentrations, or the isotopes may be collected for transfer to 200-H Area recovery systems by trapping them in appropriate materials such as zeolite.

- Nonvolatile fission products and actinides are controlled by handling them in containment systems from which all effluent streams (gaseous, liquid, and solid) are monitored.

- Pilot-scale demonstration of separations processes at full concentrations are carried out in suitably contained and shielded facilities for which appropriate hazards evaluation in terms of possible accidental releases are made before operation.

Other Facilities

- The environmental sciences laboratories (Buildings 735-A and 736-A) contain facilities for measuring and studying radiation and its effects on the environment as well as personnel monitoring activities. Research programs are conducted in geology, hydrology, meteorology, radiochemistry, radiobiology, radiation dosimetry, radiation instrumentation, soils, ecology, and limnology. Part of the limnological research is being conducted on Par Pond, a 2700-acre cooling lake for P Reactor. Part of the ecological research is being conducted in a Flowing Streams Laboratory located on the banks of Upper Three Runs at the Road C crossing. This laboratory contains facilities for studying long-range thermal effects on aquatic organisms.

- The cobalt-60 irradiation facility (Building 774-A) consists of three ^{60}Co sources (totalling in excess of 1,000,000 Ci) in a water-filled basin.

- The heat transfer laboratory (Building 786-A) is designed to test the behavior of thermally hot simulated reactor fuel elements for Savannah River production reactors under various cooling water flow conditions.

- The reactor hydraulic test facility (Building 786-A) is designed to study steam injection, transport, and quenching in a reactor mockup. Heat is vented to the atmosphere as steam or is transferred to cooling water released to a drainage ditch.

- The liquid waste disposal facility (Building 776-A) contains large tanks for short-term storage of both high-level and low-level wastes.

- The manipulator repair facility (Building 779-A) is designed to receive contaminated master-slave manipulators from the shielded facilities in the main laboratory building and from those in the production areas on the plant. The facility provides a receiving and decontamination area with containment boxes for the actual decontamination work. Contaminated liquid wastes are transferred to the liquid waste disposal facility (Building 776-A).

- The experimental physics laboratory (Building 777-M) is located just south of 300-M Area. The building houses 3 low-power test reactors and a subcritical test facility for evaluating fuel assemblies and lattice arrangements in heavy water reactors. Both natural and enriched uranium as well as plutonium and thorium are available in various shapes, and in metal, oxide, and carbide forms, in order to permit the mockup of almost any type of heavy water production reactor. Under normal operation, there are no detectable radioactive releases from experimental physics facilities.

- The TNX-CMX semiworks area is located near the Savannah River adjacent to the heavy water production and recovery plant (400-D Area). The purpose of the TNX facilities (Buildings 678-G and 679-G) is to study chemical processing problems and test production-scale equipment. Analyses are conducted with non-radioactive standins or natural uranium. The test equipment includes dissolvers for uranium metal and other nuclear materials, evaporators, mixer-settlers for solvent extraction, centrifuges, tanks, pumps, large furnaces, vacuum equipment, and distillation equipment. CMX (Building 677-G) has nine flow loops and associated equipment for non-nuclear tests of portions of hydraulic systems of Savannah River reactors; only one flow loop is currently operating.

Waste Disposal

Ventilation Systems

Control and proper filtration of air flows are the primary means of confining highly radioactive materials to the process enclosures. Outside air flows into clean areas such as offices and personnel corridors, then to potentially contaminated areas such as laboratories and utility corridors. Most of this ventilation air flow is exhausted from the laboratories through a single stage of HEPA filtration to a 100-ft stack. This air is continuously monitored for radioactive contaminants, and when detected, this air is diverted to a sand filter until the source is detected and neutralized. The remainder flows through an inlet HEPA filter into contaminated process enclosures such as glove boxes or manipulator cells and then through at least two stages of HEPA filters to the sand filters and a 160-ft stack. The effluents from the three principal stacks in the Technical Area are continuously monitored for gross alpha and beta-gamma particulates and for radioiodine. Other stacks are continuously sampled. C Stack in 773-A is continuously monitored for tritium releases.

Auxiliary diesel generating systems maintain continuous ventilation air flow in the event of the loss of the normal electrical power supply. All filters except those attached directly to process enclosures are tested on a regular schedule by measuring their retention of 0.3-μm-diameter particles of dioctylphthalate (DOP). A filtration efficiency of 99.97% is required for acceptance.

Liquid Discharge Systems

Noncontaminated Wastes. The trade waste system is designed to handle ordinary waste chemicals that are not contaminated beyond trace levels. Trade waste drains are not provided in areas where radioactive materials are used. Discharges of trade wastes from the various buildings enter a common vitreous pipe line that empties into an open ditch outside the east perimeter fence. This waste flows into Tims Branch where it is diluted with cooling water and storm drainage. This waste system is subject to a potential contamination release only in the event that radioactive material is brought into the area and a radioactive spill should occur in the vicinity of a trade waste drain or sink.

Currently two samplers are continuously operated in Tims Branch, one just after the storm sewer discharges join the trade waste effluent, the other downstream of the seepage basins after the cooling water effluent from a refrigeration building and further surface run-off water join the stream.

Contaminated Wastes. Contaminated wastes include aqueous low-level wastes and aqueous high-level wastes. The low-level aqueous waste system conducts, by gravity flow, liquid wastes through two 6-inch stainless steel lines in a concrete encasement to six underground 5,900-gallon stainless steel tanks located in Building 776-A. The wastes are sampled to verify that the activity level is within seepage basin limits (4.5×10^{-5} μCi/ml alpha and 2×10^{-5} μCi/ml beta-gamma) and is then transferred via steam jet to the seepage basins. If the activity level is too high for the seepage basin, it is transferred to the 4000-gal stainless steel tank described below for transportation to F Area.

The high-level aqueous waste system handles liquids having activity levels that preclude their discharge to the seepage basins. Two 3-inch stainless steel lines, located in the same concrete encasement as the low-level system, conduct high-level wastes to one 5,900-gallon and three 3,600-gallon stainless steel tanks located underground in Building 776-A. The wastes are transferred via steam jet to a heavily shielded stainless steel tank (4000-gallon capacity) mounted on a trailer and are transported over plant roads to F Area where they are stored in the underground waste tanks.

At the CMX-TNX semiworks, process waste is collected in a 3500-gallon underground tank. After analysis, the waste is pumped to an earthen settling basin, where solids settle out. Overflow from the settling basin joins a flow of 300 to 600 gpm of uncontaminated cooling water before entering a natural basin or depression, where additional settling occurs. The natural basin overflows to the river.

Nonradioactive Chemical Wastes. Nonradioactive wastes from SRL operations consist mainly of small amounts of chemicals that are flushed into the low-level drains or trade waste system. Some vapors are released to the hood exhaust system, and nonradioactive solids are placed in the sanitary landfill.

SRL releases about 1000 and 2000 lb/yr each of NaOH and HNO_3, respectively, to the trade waste system from fuel element fabrication operations. If these waste streams contain more than 3 g/l uranium or thorium, they are sent to 300-M Area for recovery. About 2300 lb/yr of trichloroethylene are released to the atmosphere via the ventilation system for fuel element fabrication operations. A perchloroethylene system is being installed to replace the use of trichloroethylene.

Contaminated Solid Waste Systems

All contaminated and potentially contaminated solid wastes from the Technical Area are transported over plant roads to the burial ground between F and H separations areas. Highly contaminated wastes are shipped to the burial ground in concrete containers. Transuranium wastes contaminated to greater than 10 nCi/g are shipped in galvanized steel drums. Potentially contaminated and slightly contaminated wastes are packaged in sealed cardboard containers for burial in trenches.

SUPPORT FUNCTIONS

A number of support functions are necessary to maintain the major operating facilities discussed in previous sections. These functions provide water, heat, electricity, and nonradioactive waste handling. In addition, the U.S. Forest Service manages the forests that occupy most of the 300 square miles on the site, and the Savannah River Ecology Laboratory operates an ecological research facility that utilizes the site for basic and applied research.

Water Supply and Treatment

A summary of the amounts of chemicals used in water treatment facilities is given in Appendix B.

Reactor Areas (100-P, K, C)

Water for each area is from surface sources; 100-K and 100-C use water pumped from the Savannah River. The water receives periodic chlorination at the pumphouses for slime control and flows into a large storage reservoir at each area. Process cooling water pumped from the reservoir also receives periodic chlorination to prevent slime formation in the heat exchangers. Service water for utility use is also from the reservoir.

A supply line ahead of the reservoir provides river water to a clarification-filtration plant where coagulation is effected using chlorine, alum, and lime. The filtered water is used to supply area needs for clean water: domestic, fire protection, and boiler feedwater. Deionized boiler feedwater makeup is prepared in a two-step deionization process. Sulfuric acid (H_2SO_4) and sodium hydroxide (NaOH) are used as regenerants for the ion exchange resins. These regenerants (used at $\sim$2% strength) receive moderate neutralization at P and K Areas by mixing in a small detention basin before discharge to plant streams. At C Area, which has a steam plant and no power production capability, there is no detention basin. Suspended solids removed by the alum coagulant and by filters are disposed of into waste water process sewers that discharge into plant streams.

At P Area, the principal supply of cooling and service water is Par Pond; domestic water and boiler feed water are supplied from the Savannah River. With that exception, P-Area water supply is as described above.

Separations Areas (200-F, H)

Water for each of these areas is pumped from five wells drilled into the Tuscaloosa aquifer. Two of these wells supply water continuously for the cooling of process waste in the storage facilities and for makeup to an induced draft cooling tower. Recirculated water from the cooling tower is used for miscellaneous process cooling needs. The recirculating water receives periodic chlorination and pH adjustment using NaOH. Three of the operating wells supply water for domestic, service, and fire protection needs. This water receives degasification, chlorination, and pH adjustment with NaOH. Deionized boiler feedwater is prepared in a two-step deionization process requiring H_2SO_4 and NaOH as regenerants.

Waste regenerants receive moderate neutralization by mixing in a small retention basin before discharge to Four Mile Creek.

Administration and Fuel and Target Fabrication Areas (700-A, 300-M)

Water for these areas is pumped from four wells drilled into the Tuscaloosa aquifer. The well water receives pH adjustment with lime as it enters steel storage tanks. Water entering the domestic water system is also chlorinated for disinfection. The water is distributed using three underground piping systems: domestic, service, and fire protection. Well water is used directly for boiler feedwater, with Dearborn 659* (a synthetic sludge conditioner) trisodium phosphate, sodium sulfite, and NaOH as treatment chemicals. Waste water leaves the area by way of Tims Branch to Upper Three Runs.

Heavy Water Area (400-D)

Water for this area is pumped from the Savannah River. This supply receives periodic chlorination for slime control at the pumphouse. Water in the area is distributed to the powerhouse for condenser cooling and to the water treatment plant for preparation of feedwater for heavy water production.

The water treatment plant uses chlorine, alum, and lime to clarify the water. This filtered water is used for domestic, fire protection, and boiler feedwater as well as for feedwater for heavy water production. Feedwater for the production area is acidified, deaerated, and pH adjusted with caustic following filtration. In addition to filtration, the boiler feedwater is deionized using a two-step deionization process requiring H_2SO_4 and NaOH as regenerants. Water regenerants are discharged directly to the waste water sewer and receive dilution with once-through cooling water. The waste water discharges to Beaver Dam Creek.

Sanitary Waste Treatment

Waste water treatment plants are provided in major populated facilities to treat sanitary sewage. The sewage is collected in

* Registered trademark of Dearborn Chemical Co.

systems that exclude surface, cooling, or process water; major facilities are summarized in Table II-1. Septic tanks with tile fields are provided for peripheral gatehouses and isolated buildings (Table II-2).

During plant construction, five sewage lagoons provided part of the sanitary waste treatment for the large number of employees present on the site. None of these lagoons are still in service. Two lagoons used for the Temporary Construction Administration Area (U Area) were replaced in 1957 with a single Imhoff tank. Some of the lagoons were covered with earth; the remaining lagoons were abandoned in place and are presently covered with lush growths of trees and plants.

Steam and Electricity Generation

The steam supply for the plant is provided by spreader stoker and pulverized wet bottom boilers. Consumption of coal, which is obtained from several suppliers, is currently about 520,000 tons per year. The sulfur content of the coal has ranged between 1.0% and 1.5%. Ash content of the coal has increased from about 9% in the 1950's to the present level of 13%. Airborne effluents consist of fly ash, carbon dioxide, carbon monoxide, SO_2, and NO_x. Estimates (Table II-3) have been made of the releases of SO_2 and fly ash from the power facilities. SO_2 concentrations in ambient air in the vicinity of the largest power plant have been measured (page III-59).

Water is used to slurry the remaining ash and convey it to ash basins in most areas (Table II-4). Analyses of the effluent from the ash basins are described in Section III A-7.

Diesel engines coupled to emergency generators provide electricity to critical equipment if normal supplies should be unavailable. The diesel engines are tested periodically. Gaseous effluents consist primarily of unburned hydrocarbons, carbon dioxide, carbon monoxide, SO_2, NO_x, and a small amount of particulate matter.

Miscellaneous Nonradioactive Waste Handling

Solid Waste

General industrial trash consists primarily of paper products with relatively small amounts of plastics, lumber, rags, cans, and glass products. Trash generated during 1975 was about 6,300,000 lb. Before October 1, 1973, this trash was burned in

TABLE II-1

Major Area Sewage Treatment Facilities

Area	*Population*	*Capacity, gal/day*	*Type*
300-M, 700-A	2739	130,000	Extended Aeration
200-F	709	40,000	" "
200-H	719	29,000	" "
100-P	329	12,000	" "
400-D	294	12,000	" "
Central Shops	337	10,000	" "
100-K	273	16,000	Septic Tanks/Tile Field
100-C	389	17,000	" "
CMX-TNX	31	6,250	" "
TC-1, 704-U	50	85,000	Imhoff Tank/Tile Field

TABLE II-2

Location of Other Septic Tanks with Tile Fields

681-1G	River Pumphouse
681-3G	River Pumphouse
681-6G	Par Pond Pump House
681-G	RR Classification Yard
760-G	Forestry - Ecology
701-2G	Allendale Gatehouse
701-3G	Barnwell Gatehouse
701-4G	Williston Gatehouse
701-5G	Aiken Gatehouse
701-6G	Augusta Gatehouse
776-A	Waste Handling Control House
661-G	Pistol Range
735-2G	Limnology Field Laboratory
241-F	Waste Farm Control House

TABLE II-3

Summary of Power Facility Operations at SRP

Location		Equipment Data					Fuel Data			
Area	*Source*	*Service*	*Type Units*	*Size of Units*[a]	*Number of Units*	*In Service Date*[b]	*Type Fuel*	*Tons*[c] *per Yr*	*% S*[d]	*% Ash*[e]
700-A	784-A	Steam Generator	Spreader Stoker	71.7	2	10/52	Bituminous Coal	19,200	1.09	13.25
100-C	108-C	DC Generator	IC Engine	1.4	8	10/54	#2 Fuel Oil	Gal 258,000	0.09	<0.001
	184-C	Steam Generator	Spreader Stoker	43.8	2	9/54	Bituminous Coal	6,000	1.09	13.25
400-D	484-D	Steam and Electric Generator	Pulverized Wet Bottom	396	4	7/52	Bituminous Coal	333,500	1.39	11.90
200-F	284-F	Steam Generator	Spreader Stoker	71.7	4	11/53	Bituminous Coal	31,300	1.09	13.25
CMX-TNX	679-G	Steam Generator	Rotary Burner	20.8	1	/54	#2 Fuel Oil	Gal 171,000	0.09	<0.001
200-H	284-H	Steam Generator	Spreader Stoker	71.7	3	11/54	Bituminous Coal	30,400	1.09	13.25
100-K	108-K	DC Generator	IC Engine	1.4	8	7/54	#2 Fuel Oil	Gal 271,000	0.09	<0.001
	184-K	Steam and Electric Generator	Spreader Stoker	194.5	2	5/54	Bituminous Coal	49,100	1.09	13.25
100-P	108-P	DC Generator	IC Engine	1.4	8	6/53	#2 Fuel Oil	Gal 261,000	0.09	<0.001
	184-P	Steam and Electric Generator	Spreader Stoker	194.5	2	4/53	Bituminous Coal	47,800	1.09	13.25
700-U	789-U	Steam Generator	Gun Burner	3.2	2	/51	#5 Fuel Oil	Gal 11,500	0.09	<0.001

a. Size of units in 10^6 BTU/hr input.

b. Date first unit placed in service.

c. Fuel oil quantities are for calendar year 1975. Coal quantities are for calendar year 1975. These quantities are representative of current operations.

d. Average of current analyses. Sulfur content of coal has varied from approximately 1.0 to 1.5%.

e. Average of current analyses. Ash content has increased from approximately 9% in .he 1950's to its present level.

TABLE II-3 (Continued

Location		Air Cleaning Equipment		Estimate of Contaminants	
Area	Source	Type	% Efficiency[f]	Type	Tons[g] per yr
700-A	784-A	Cyclone	89	Fly Ash	135
				SO_2	415
				Ash	2,440
100-C	108-C	None		SO_2	1
	184-C	Cyclone	86	Fly Ash	95
				SO_2	130
				Ash	700
400-D	484-D	Cyclone	74	Fly Ash	10,600
				SO_2	9,270
				Ash	28,600
200-F	284-F	Cyclone	86	Fly Ash	210
				SO_2	685
				Ash	3,950
CMX-TNX	679-G	None		SO_2	1
200-H	284-H	Cyclone	85	Fly Ash	195
				SO_2	660
				Ash	3,775
100-K	108-K	None		SO_2	1
	184-K	Cyclone	98	Fly Ash	1,030
				SO_2	1,070
				Ash	5,470
100-P	108-P	None		SO_2	1
	184-P	Cyclone	98	Fly Ash	1,000
				SO_2	1,045
				Ash	5,325

f. Efficiencies based on tests performed during period 1953 to 1955, except 484-D which was last tested in 1969. The indicated efficiency and annual emissions from 484-D are valid through 1975. Since early 1976 electrostatic precipitations have been in service, with efficiencies >99%. Emissions from 484-D for 1976 are expected to be about 25% of the indicated values, and in future years <1%.

g. Estimate of fly ash based on dust collector outlet tests conducted on each type stoker fired boiler in March and April 1973, and 484-D dust collector test in 1969.

TABLE II-4

Water Used to Convey Ash from Power Plants to Ash Basins

Area	*Estimated Annual Flow, millions of gallons*
100-P	132
100-K	108
200-F	158
200-H	155
400-D	1315
700-A	0[a]
100-C	0[a]

a. Ash transferred by truck rather than slurry.

pits. In 1973, seven burning pits were operated. Approximate burning frequency was semimonthly in A Area, monthly in C, K, P, F, and D Areas, and infrequently at Construction Shops (R Area pit was closed in 1965, L Area in 1969). Beginning October 1, 1973, a sanitary landfill operation (Figure II-2) was initiated to replace the burning pits. The burning pits are being filled with bulk solid wastes, rubble, etc., and are being topped off and returned to useful service, such as for forestry management.

Waste Oil and Lubricants

The burnable portion of waste oils and lubricants consists primarily of crank case oils, gear box oils or fluids, and general lubricant products. Current volume is estimated at 22,800 gallons or 182,400 lb/yr. Past practice was to dispose of this oil at burning pits for consumption with trash. Since July 1, 1973, the burnable oil has been delivered to the D-Area powerhouse for boiler fuel.

Pesticides

Use of chemical pesticides at SRP has been limited primarily to the application of herbicides. Present use of herbicides is dictated by relative economics of manual versus chemical removal of unwanted plant growth. Herbicides are applied to power line, water line, and railroad rights of way, on highway embankments, and around transformer stations or storage yards. Insecticides are used in food preparation and office areas to control disease-carrying and destructive insects.

Rates and formulations are controlled in accordance with Environmental Protection Agency guidelines, and no applications are made which cause measurable runoff on watersheds or to streams. Chemicals purchased for application in 1975 are listed in Table II-5. In August 1971, a burial site designated for disposal of empty pesticide containers was placed in service. Previously, these containers were disposed of in trash burning pits.

Forest Management

The U.S. Forest Service has managed forest activities at SRP since 1952 and has conducted an extensive forest management program. Major efforts have been tree establishment, controlled burns to maintain a low fire hazard, chemical treatment programs to control insects and hardwood growth in young pine plantation areas, and timber harvest. Forest fires have occurred each year and have generally affected small areas. Details of the areas affected since 1954 by each of these activities are given in Appendix B. The effects of present forest management programs are described in Section III.

TABLE II-5

Pesticide Applications in 1975

Common Name	*Approximate Quantity Purchased per Year*
Karmex	4,000 lb
Dow Pon 'C'	2,000 lb
Ammate X	4,000 lb
2,4 D Amine	120 gal
Malathion	100 gal
Surfactant	100 gal
Chlordane	40 lb
Chlordane liquid	10 gal

The Savannah River Ecology Laboratory

The Savannah River Ecology Laboratory, operated by the University of Georgia, has conducted extensive ecological investigations on the Savannah River Plant site since 1961. These investigations have taken place on approximately 100 different locations ranging in size from small plots to studies on the 2700-acre cooling reservoir (Par Pond).

There have been no long-term chemical, radionuclide, or thermal releases by SREL to the SRP environment. All releases have been of comparatively short duration as part of scientific experimentation. Less than 1000 lb of chemicals has been applied to the soil. Approximately 0.2 lb of mercury has also been released as a consequence of experimental research. Some releases of short-lived radioisotopes from tracer studies on various environmental questions have occurred, but the releases have been minimal (less than 100 mCi).